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MONEY LAUNDERING - A QUANTITATIVE ANALYSIS OF KNOWLEDGE PRODUCTION AND ITS ECONOMICS AND SOCIAL RELATION

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Dissertation presented as partial requirement for obtaining the Master's degree in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação
Universidade Nova de Lisboa

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by

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Master Thesis presented as partial requirement for obtaining the Master's degree in Information Management/ Master's degree in Information Management, with a specialization in Business Intelligence and Knowledge Management

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

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DEDICATION

Dedicado à minha mãe, feito com a perseverança,

esforço e trabalho que me incutiste desde sempre.

Uma conquista pessoal que é o culminar

dos valores que me transmitiste.

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ABSTRACT

Money Laundering has been a concern of the major entities in the world. By 2020 it was estimated that 2.7% of the global GDP is money laundered by criminals. This study quantifies the knowledge produced on money laundering subject and which concepts are related to it. The data source used was the Web of Science database available at Web of Science website. The main players and networks around them were set, and the exercise of understanding the money laundering bibliometrics conducted to investigate potential relations between knowledge creation and corruption, terrorism, and financial transparency. It was concluded that Money Laundering turned into a relevant topic in science production since 2015, and the four main players are USA, China, UK, and Australia. Regarding the relation dynamics, it was found a good correlation between science production and number of citations, and the Financial Secrecy Index, meaning that countries with more articles produced, and with more citations are more likely to be less transparent, being the four main players above the trend.

KEYWORDS

Money Laundering; Bibliometrics; Corruption; Terrorism; Financial Transparency

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LIST OF ABBREVIATIONS AND ACRONYMS

AML	Anti Money Laundering
CPI	Corruption Perceptions Index
CFT	Combating the Financing of Terrorism
EU	European Union
FACTI	The High-Level Panel on International Accountability, Transparency and Integrity for Achieving the 2030 Agenda
FATF	Financial Action Task Force
FBI	Federal Bureau of Investigation
GTI	Global Terrorism Index
M	Millions
ML	Money Laundering
UK	United Kingdom
UN	United Nations
USA	United States of America
TF	Terrorism Financing
WoS	Web of Science

1. INTRODUCTION

Money laundering can be defined as the activity of covering the existence of income from an illegal source, or the use of income derived from unlawful activity, and consequent disguising of its origin in order to seem legitimate (Zdanowicz, 2009).

According to the Financial Action Task Force, the inter-governmental policymaking body, "*the goal of a large number of criminal acts is to generate a profit for the individual or group that carries out the act. Money laundering* (…) *is of critical importance, as it enables the criminal to enjoy these profits without jeopardising their source.*" (FATF, 2021)

By September 2020, it was estimated by The High-Level Panel on International Financial Accountability, Transparency and Integrity for Achieving the 2030 Agenda that 2.7% of global Gross Domestic Product (GDP) is money laundered by criminals (FACTI, 2020).

Regarding impacts, the Money Laundering activity is destructive for the monetary system, carrying negative impacts to the social and safety population sphere as well. Since Money Laundering processes help criminal agents like terrorists, corrupt governments, and others, managing their criminal exposures, it is faced as having a critical role in global crime (Islam & Nasir, 2020).

Systematic reviews of Money Laundering have been written mainly focused on the potential science production gaps, as the lack of research performed in money laundering and shell companies (Tiwari et al., 2020). However, according to the author's best knowledge, researches focused on where the study activity is coming from, and how it could be potentially related to macroeconomics and social trends were not found.

As such, this study is divided into two major research topics. The first one is focused on quantitative analysis of the knowledge produced on Money Laundering and related concepts. It was also studied its evolution over time regarding the number of written papers, its geographical distribution, citations' origin, disciplinary categories, and keywords. This chapter should contribute for a better characterization of the science production worldwide about the Money Laundering subject. The second research chapter is focused on the construction of correlations between knowledge production and economic and social trends. For that, the following indicators were studied: Corruption Perceptions Index ("CPI")[1], Global Terrorism Index ("GTI")[2] and Financial Secrecy Index ("FSI")[3].

Based on the above mentioned, the project aims to address questions on Money Laundering field as: When did Money Laundering start to be a science concern? What issues are linked to Money Laundering? What players and geographies have been most concerned on the topic? How is Money Laundering knowledge production related to corruption, terrorism, and financial secrecy?

This manuscript is organized as follows: Section 2 consists of a brief literature review on the Money Laundering subject and on measuring research. Section 3 outlines the applied methodology. Section 4 presents results. Section 5 consists of conclusion.

[1] CPI by Transparency International
[2] GTI by Institute for Economics & Peace
[3] FSY by Tax Justice Network

2. LITERATURE REVIEW

2.1. MONEY LAUNDERING

Concerns about Money Laundering surfaced in global institutions before the year 2000. In 1996, International Monetary Fund defined Money Laundering as one of the main problems to be dealt by financial community (Camdessus, 1998).

Currently, the main world institutions are still aware of Money Laundering's problematic. Therefore, United Nations (UN) created the FACTI Panel which aims to contribute on the implementation of 2030 Agenda for Sustainable Development, where world money laundering issues are being addressed (FACTI, 2020).

Money Laundering can be defined as the activity of covering the existence of income from an illegal source, or the use of income derived from unlawful activity, and consequent disguising of its origin in order to seem legitimate (Zdanowicz, 2009).

According to the Financial Action Task Force (FATF) "*the goal of a large number of criminal acts is to generate a profit for the individual or group that carries out the act. Money laundering* (…) *is of critical importance, as it enables the criminal to enjoy these profits without jeopardising their source.*" (FATF, 2021)

The Money Laundering nefarious impacts in economics – in monetary system – and in society – as a process which allows criminals to reduce their income origin exposure (Islam & Nasir, 2020), conduct regulatory institutions to adopt measures to fight against it with impact in bank valuations (Premti et al., 2021).

2.2. FINANCING OF TERRORISM

Usually, Financing of Terrorism ("FT") appears linked to the Money Laundering concept, especially in what regards to the regulations and laws which aim to combat them. The European Union (EU) have been implementing directives and law proposals which group these two concepts with the aim of "*prevent the use of the Union's financial system for the purposes of money laundering and terrorist financing*"[4].

Terrorism is defined by the EU[5] as acts committed with aim of "*seriously intimidating a population*" or "*unduly compelling a government or an international organization to perform or abstain from performing any act*", or "*seriously establishing or destroying the fundamental political, constitutional, economic or social structures of a country or an international organization*". Moreover, EU establishes a list of acts which can be faced as terrorism offences as attacks upon a person's life or integrity, kidnapping or hostage-taking, causing extensive destruction to a government, public infrastructures or private property, among others.

[4] Directive (EU) 2015/849
[5] Directive (EU) 2017/541

The Federal Bureau of Investigation ("FBI") defines terrorism as "*violent, criminal acts committed by individuals and/or groups to further ideological goals stemming from domestic influences, such as those of a political, religious, social, racial, or environmental nature*" (FBI, 2022).

With the need to draw laws regarding Money Laundering and Financing of Terrorism two concepts arose: Anti Money Laundering, usually referred as AML and Combating the Financing of Terrorism usually referred as CFT.

Finally, the cryptocurrencies and their respective conversion vehicles opened a new chapter in Money Laundering and Financing of Terrorism discussion, giving a new way for criminals to launder significant amounts of money without being detected (Dupuis & Gleason, 2021).

2.3. RESEARCH QUANTITATIVE ANALYSIS

Science can be studied and build over diversified methods depending on the object of science and the sociological, historical, and philosophical perspectives. It is in this context that measuring research could bring unique insights regarding science itself and its relational and contextual elements. Such insights might be used to complement other scientific studies as well as to bring new inputs on how and where knowledge is being produced over time (R. Jones, 2018).

This type of quantitative study (citation of published articles, their respective authors, and the journals where they were published) is defined as bibliometrics, sometimes referred to as scientometrics (A. W. Jones, 2015). Bibliometrics has particular added value when the data volume is above the processing human capacity, for example when it is aimed to measure relational data like citations (R. Jones, 2018). The analysis of citations allows building relationships between the cited and the citing paper (Andres, 2009), making possible to create science network.

Beyond the above-mentioned benefits, through the quantitative analysis of information about scientific activity, bibliometrics could influence the decisions of administrations and political actors. Moreover, the outputs of research quantitative analysis might contribute to stimulate research, allocate resources, and understand and forecast trends in science (R. Jones, 2018).

Recent events as terrorist attacks to European countries and Panama Papers have highlighted the importance of addressing the AML/CFT legislation in a determined and effective way in order to ensure that all the nations involved are cooperating better and change key information worldwide (Silva, 2019). Silva, 2019 concluded that the law only reaches its potential if there is a coordinated response and a harmonized legal framework from all actors involved (Member States, third countries, institutions, or agencies at a global level) avoiding overlapping and redundancies. So, since the combat to Money Laundering and Financing of Terrorism cannot be faced as a singular problem of each nation, beyond of the knowledge provided by a bibliometrics study, these studies could provide relevant insights in order to better draw laws and apply them worldwide.

2.4. ECONOMIC AND SOCIAL TRENDS

2.4.1. Corruption Perceptions Index ("CPI")

The CPI is constructed by Transparency International and ranks 180 countries and territories, giving to them a score according to their perceived levels of public sector corruption, according to experts and business people (Transparency International, 2020).

CPI aggregates data from thirteen different sources from twelve different institutions that storage information regarding perception of corruption within the past two years. After the collection phase, these data sources are standardized in a scale of 0-100 (Transparency International, 2020). "*This standardization is done by subtracting the mean of each source in the baseline year from each country score, then dividing by the standard deviation of that source in the baseline year. This subtraction and division using the baseline year parameters ensures that the CPI scores are comparable year on year since 2012. After this procedure, the standardized scores are transformed to the CPI scale by multiplying them with the value of the CPI standard deviation in 2012 (20) and adding the mean of the CPI in 2012 (45), so that the dataset fits the CPI's 0-100 scale"* (Transparency International, 2020, p. 26). Then a rounded average is calculated for each country, being that a country must have a minimum of three sources available. This average represents the score of a country in a increasing scale, i.e., as higher the score lower the corruption (Transparency International, 2020).

2.4.2. Global Terrorism Index ("GTI")

The GTI is built by Institute for Economics and Peace ("IEP") and assesses the impact of terrorism in 163 countries, which covers 99.7% of the total world population (Institute for Economics and Peace, 2022).

To calculate the score of each country, it is considered the data from TerrorismTracker available on Drangonfly SIAS platform which contain worldwide terrorism incidents. In order to guarantee alignment between the events considered, the IEP accepts the definition and terminology used by TeorrismTracker. So, for IEP terrorism is "*the systematic threat or use of violence, by non-state actors, whether for or in opposition to established authority, with the intention of communicating a political, religious or ideological message to a group larger than the victim group, by generating fear and so altering (or attempting to alter) the behavior of the larger group*" (Institute for Economics and Peace, 2022, p. 6). It is excluded from GTI calculation events as acts of warfare, violence exclusively focused on profit, aggressive anti-social behavior, civil unrest, and isolated violence acts practiced by unbalanced people (Institute for Economics and Peace, 2022).

For the actual calculation of each country's score, four factors with different multipliers are considered for a given year: total number of terrorist incidents (multiplier is 1), total number of deaths caused by terrorists incidents (multiplier is 3), total number of injuries caused by terrorists incidents (multiplier is 0.5) and total number of hostages made in terrorists incidents (multiplier is 0.5). Therefore the final score is given by the total number of incidents added by three times the number of deaths, added by 0.5 times the number of injuries added by 0.5 times the number of hostages. (Institute for Economics and Peace, 2022). So, as higher the score, more exposed to terrorism the countries were.

2.4.3. Financial Secrecy Index

The Financial Secrecy Index is constructed by the Tax Justice Network and aims to quantify how each jurisdiction contributes to the global problem of financial secrecy (Tax Justice Network, 2022). The index is calculated based on qualitative and quantitative data. The qualitative data is based on laws, regulations and cooperation in information sharing processes, and other verifiable data sources, while the quantitative data consists of publicly available data about trading activity in international services of each jurisdiction (Tax Justice Network, 2022). The qualitative data is used to calculate the secrecy score for each country and the quantitative data is then used to create a global scale weighting, according to its share of offshore financial services activity in the worldwide total. There are 20 secrecy indicators which range from 0 to 100 and the final score is an arithmetic average of all 20 (Tax Justice Network, 2022).

The secrecy indicators are banking secrecy, trusts and foundations register, recorded company ownership, other wealth ownership, limited partnership transparency, transparency of company ownership, public company accounts, country by country reporting, corporate tax disclosure, legal entity identifier, tax administration capacity, consistent personal income, avoids promoting tax evasion, tax court secrecy, harmful structures, public statistics, anti-money laundering, automatic information exchange, exchange of information upon request and international legal cooperation (Tax Justice Network, 2022). The closest a given jurisdiction is to 0, more transparent the country is considered (Tax Justice Network, 2022).

3. METHODOLOGY

To perform a bibliometric study the following phases must be taking into consideration: the study design which was already presented in the Introduction chapter, the data collection, the data analysis and data visualization and interpretation (Aria & Cuccurullo, 2017).

3.1. DATA COLLECTION

In the data collection phase, the work was divided into three sub-stages. The first one was the data search and collection (Aria & Cuccurullo, 2017), using the Web of Science[6] (WoS) database as the data source. WoS is considered a robust database correlated with other databases as Scopus (Archambault et al., 2009).

[6] WoS at http://www.webofknowledge.com

In this sub-stage, the procedure followed was to perform a search for all the data bases and indexes available at WoS with no restrictions, being "Money Laundering", the topic searched. The "topic" concept in WoS means that the search included all documents which contains the expression "Money Laundering" in the title, or keywords, or abstract, or authors keywords or keywords plus. Figure 1 presents the data collection procedure which results in 1,669 documents found. However, five false positives were found being the main false positive matches related to microbiology present in money (cash). Therefore, the final data set counts with 1,664 documents.

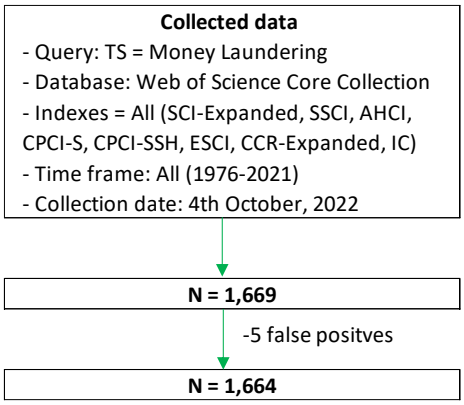

Figure 1 - Data collection procedure.

The second sub-stage was the data loading and conversion in a format compatible with the usage of the *bibliometrix* tool. The last sub-stage consists of data cleaning and preparation (Aria & Cuccurullo, 2017).

3.2. DATA ANALYSIS

Data analysis was focused on a descriptive analysis of the data collected (Mendonça et al., 2022). The analysis was based on the following categories:

3.2.1. Geography and population

In order to understand where the science production comes from, the data was grouped into countries which rolls up into continents, considering the authors affiliations. This category aims to define knowledge networks between the countries and/or continents and where are located the main actors (in production and citations) in Money Laundering subject.

For building relative analysis considering the countries' population, the data was processed by using the R package 'wppExplorer'.

3.2.2. Knowledge categories

The disciplinary analysis of the studies published on Money Laundering area was made considering the WoS disciplinary categories and proceeding with a regroup of such categories in broader fields. Consequently, the 62 disciplines found from Money Laundering data processing were grouped into 12 broader fields (Appendix A).

3.2.3. Keywords

The keywords data processing required a significant cleaning and standardization process. All stresses, punctuation marks and special characters were removed. Also, plural words were converted into singular form and abbreviations and extended versions for the same word or meaning were standardized.

3.3. DATA VISUALIZATION AND INTERPRETATION

The data visualization phase consists of the creation of an end-user intuitive format to read the project's results. In order to achieve it, the author plotted several graphs by using R programming language, and when required tables with data details were also constructed.

The visuals' construction was helpful to interpret the results obtained and take deeper and more accurate conclusions on the results of the data analysis phase.

3.4. RELATION DYNAMICS

Regarding the construction of relation dynamics with macroeconomics and social trends the following approach was followed:

1. Collecting data
2. Formulating hypothesis and the null hypothesis – E.g.: Is the quantity of science production in a specific geography related to the countries' corruption index?
3. Testing the hypothesis
4. Results' interpretation
5. Conclusions

The hypothesis tests were made with a 95% confidence interval and the correlation used was the Pearson correlation. The universe for building the correlation is characterized by the countries with more relevant presence on publishing (top thirty) and the variables analyzed were the total number of studies published, the total number of studies published by 1 million habitants and the total number of citations. The economic and social trends were chosen based on the keywords results, together with money laundering related themes according to the literature. The indexes' data was collected based on the most recent calculation, being for all cases referred to 2021.

4. RESULTS

4.1. OVERVIEW OF STUDIES PUBLISHED ON MONEY LAUNDERING TO 2021

The first study on Money Laundering subject was published in 1995 and the science production had remained under 20 studies per year until 2005. From 2006 to 2014 the studies published sliglhty increased and in 2015 there was a clear take-off when the volume jumps to more than 90 studies publisehd per year. By processing the authorship information, it is possible to observe that the evolution of the number of countries contributing for the science production on Money Laundering subject is in line with the evolution of the total number of studies published. Figure 2 shows the evolution of the number of studies published as well as the number of countries involved in the Money Laundering studies publication.

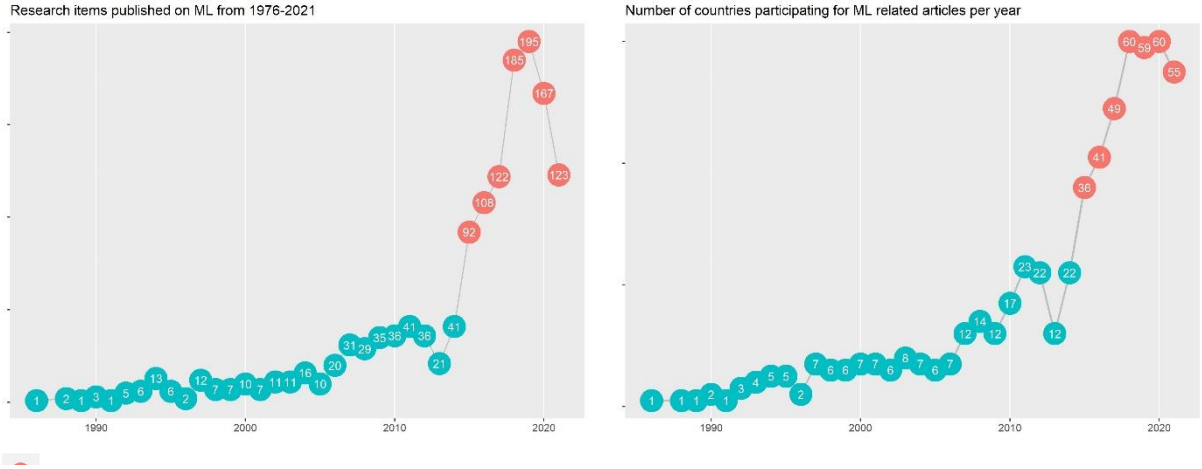

Figure 2 - Evolution of the number of studies published on ML.

Figure 3 shows the worldwide distribution of the number of studies published. The world map represents all authors' distribution regardless of the difference between the first and the other authors. The countries that have been contributing the most are USA, UK and China, and the continent that have less number countries involved on Money Laundering publishing is Africa. However, when comparing the total studies with the countries' population, Switzerland led the contribution to the Money Laundering publishing by far when compared to the other countries, as can be observed in Figure 4. USA drops to 19th most relevant country and China to 28th one, while UK remains in the top 10, having Australia a more consistent behavior being the 4th country with more publications and the 3rd one with more publications per habitant. Overall, in both analysis there is a predominance of European countries, but the 5 continents are presented in the top 30. In that sense it is possible to observe a general globalization in Money Laundering publishing. Regarding the relevance of the studies published, USA, UK and China remains in the top 3 countries with a greater number of citations, followed again by Australia, as it is possible to observe in Figure 5 that shows the total number of citations from authors of each country. Therefore, when analyzing Figures 3, 4 and 5 together it is possible to conclude that Australia is the country which is constantly in the top four of the most relevant countries in Money Laundering publishing even when relatively compared with its population.

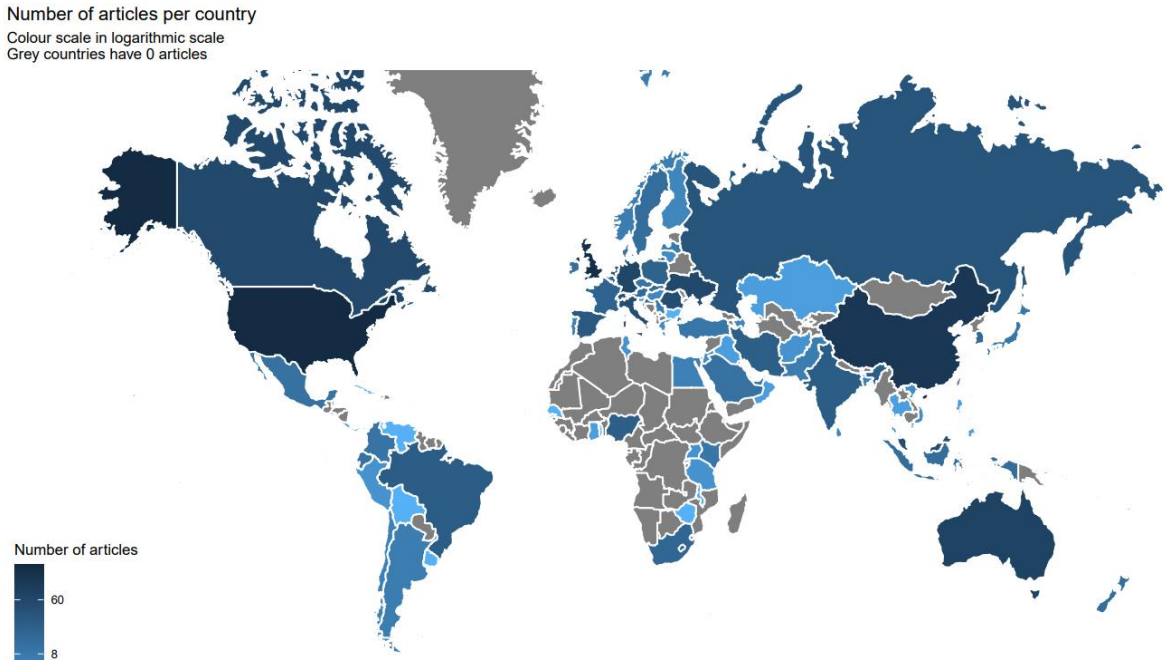

Figure 4 - ML publishing worldwide distribution.

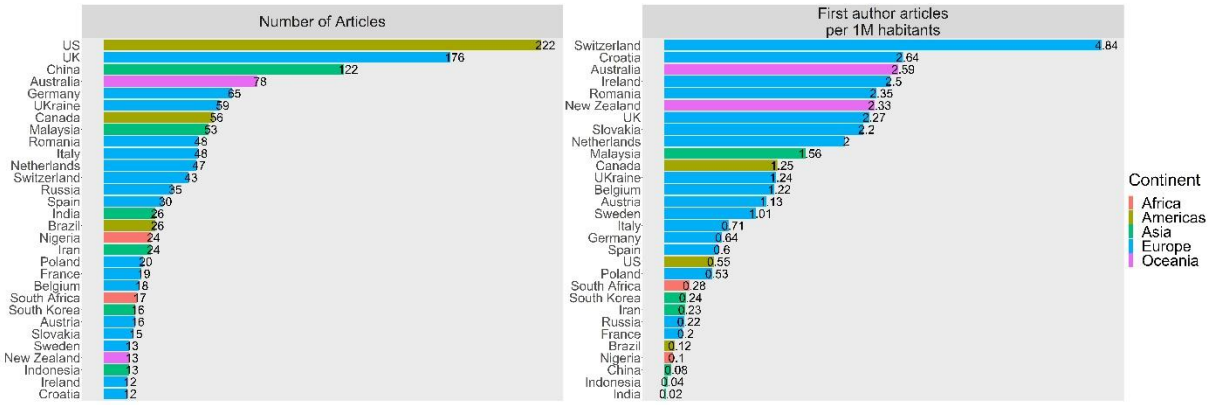

Figure 3 - Comparison between total and by 1M habitants articles published

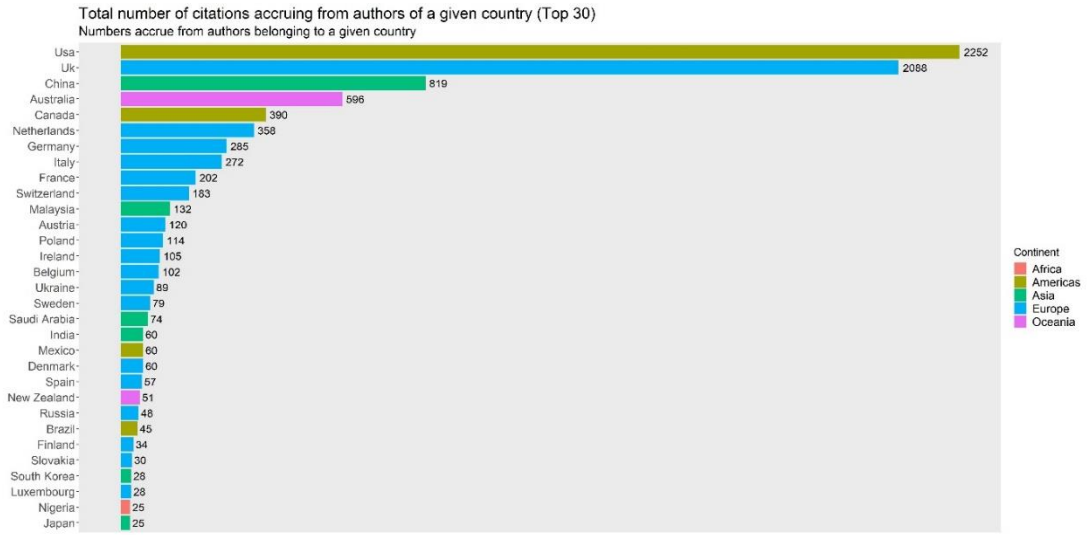

Figure 5 - Total number of citations per country

4.2. COUNTRY NETWORKS

Table 1 represents the Top 26 countries collaborations on publishing about Money Laundering measured by the number of studies co-authored. USA and China, which are the countries that more contributed to science production on Money Laundering subject, are also the countries which more collaborated between each other. China is more likely to collaborate with non-European countries – 19 co-authored publications with non-European countries against 6 co-authored publications with European countries – in line with Australia – 21 co-authored publications with non-European countries against 5 co-authored publications with European countries – while USA is slightly more balanced in its collaborations – 27 co-authored publications with non-European countries against 17 co-authored publications with European countries. In general, USA is the most diversified collaborative country leading the ranking with 9 appearances, followed by UK and Australia (both 7 appearances), and China (5 appearances).

Table 1 - Countries collaboration

Country 1	Country 2	Articles together
CHINA	USA	13
UK	USA	10
CHINA	AUSTRALIA	6
CANADA	USA	6
UK	AUSTRALIA	5
UK	NETHERLANDS	5
UK	NIGERIA	5
AUSTRALIA	NEW ZEALAND	4
AUSTRALIA	MALAYSIA	4
AUSTRALIA	USA	4
AUSTRALIA	GERMANY	4
CHINA	UK	3
BANGLADESH	AUSTRALIA	3
CHINA	SAUDI ARABIA	3
SWITZERLAND	USA	3
USA	NETHERLANDS	3
UK	ITALY	3
AUSTRIA	ITALY	3
CHINA	GERMANY	3
USA	GERMANY	3
NETHERLANDS	GERMANY	3
USA	SWEDEN	3
CROATIA	SERBIA	3
USA	BRAZIL	3
UKRAINE	AZERBAIJAN	3

Figure 6 displays a representation of the network of authorship. The network has a density of 0.07, meaning the proportion of existing links relative to the possible number. The diameter is 7, meaning the shortest distance between the two farthest nodes, and the average path-length is 2.78. Within the network eight groups of countries were identified, being that four of them are centered in the most relevant countries (USA, China, UK and Australia) while the other four clusters are significant smaller and correspond to niche collaborations.

Table 2 shows the countries' influence and position in the worldwide network, by measuring the degree, betweenness and closeness. The degree measures the diversity of the country's network, the betweenness measures the country's centrality (length of paths to other nodes) and the closeness measures the average distance the country and all others. Despite there are clearly top four countries leading the Money Laundering science production (USA, China, UK and Australia), regarding collaboration China appears as a less collaborative country when compared to the other three. Therefore, the global collaboration results for China – one of countries with more collaborations – it is pushed by its collaboration with USA (13 articles in total). Beyond that, China appears has a not so close country to work with within Money Laundering subject, while USA and UK lead the collaboration statistics, and Australia appears in top five of the closest countries to work with.

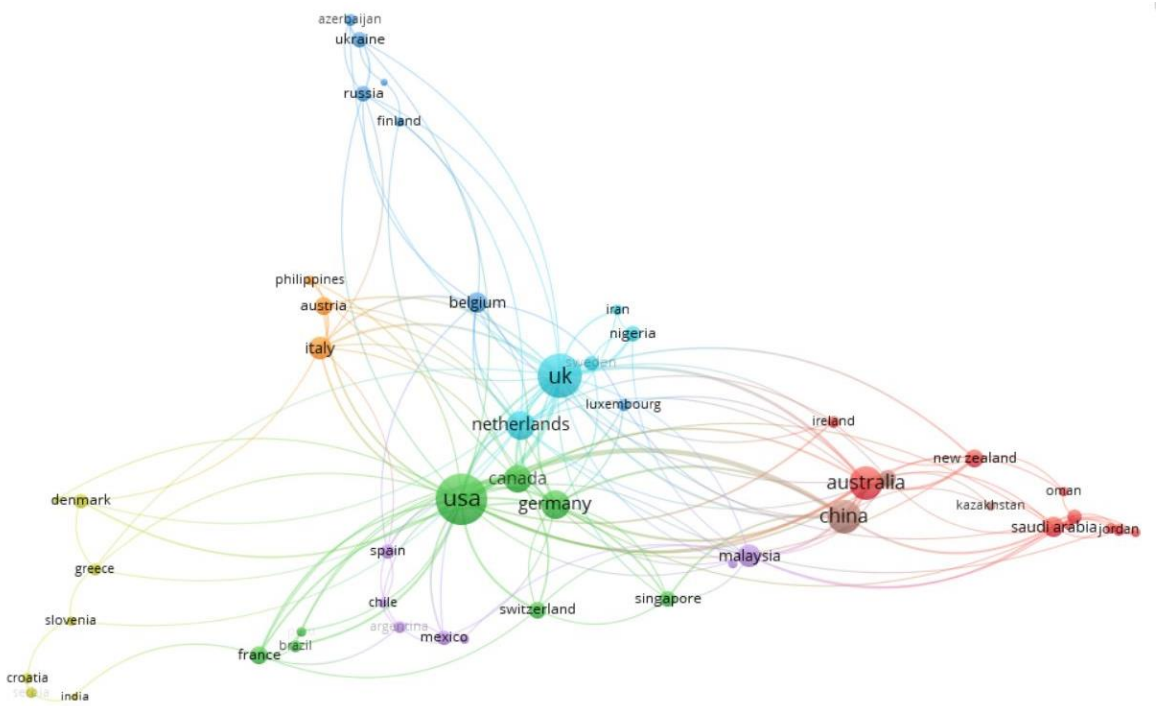

Figure 6 - Countries collaboration network.

Table 2 - Countries influence in the worldwide network

Country 1	Degree	Country 2	Betweeness	Country 3	Closeness
USA	0.4647887	USA	0.5236087	USA	0.1588367
UK	0.3661972	UK	0.2209074	UK	0.1533477
CANADA	0.2253521	NETHERLANDS	0.1782403	NETHERLANDS	0.1504237
NETHERLANDS	0.2253521	GERMANY	0.1219238	AUSTRALIA	0.1488470
GERMANY	0.2112676	CANADA	0.1058869	GERMANY	0.1476091
AUSTRALIA	0.1971831	AUSTRALIA	0.0986825	SOUTH KOREA	0.1460905
MALAYSIA	0.1830986	MEXICO	0.0808853	MALAYSIA	0.1451943
BELGIUM	0.1549296	MALAYSIA	0.0680525	ITALY	0.1440162
SAUDI ARABIA	0.1549296	SAUDI ARABIA	0.0646642	CHINA	0.1437247
ITALY	0.1408451	UNITED ARAB EMIRATES	0.0645861	GREECE	0.1428571
CHINA	0.1267606	FRANCE	0.0561569	UKRAINE	0.1422846
RUSSIA	0.1126761	ITALY	0.0561433	CANADA	0.1420000
FRANCE	0.1126761	ARGENTINA	0.0557344	NEW ZEALAND	0.1420000
SOUTH KOREA	0.1126761	ROMANIA	0.0555332	DENMARK	0.1420000
UNITED ARAB EMIRATES	0.0985915	SLOVENIA	0.0526291	RUSSIA	0.1417166
UKRAINE	0.0845070	UKRAINE	0.0518846	AUSTRIA	0.1417166
SWITZERLAND	0.0845070	BELGIUM	0.0463403	SAUDI ARABIA	0.1414343
SPAIN	0.0845070	IRAN	0.0290771	BELGIUM	0.1405941
AUSTRIA	0.0845070	INDIA	0.0286586	SWEDEN	0.1403162
NEW ZEALAND	0.0845070	RUSSIA	0.0281690	MEXICO	0.1389432

4.3. KNOWLEDGE CATEGORIES AND KEYWORDS

Table 3 shows the production of science grouped by category. More than one third of the studies published in Money Laundering subject are within social sciences and humanities area. However, the studies published in the category environment are the ones which have a higher average citation. By processing the information of the publishing activity per year per category (Figure 7), it is possible to observe that the most significant categories – social sciences and humanities, public policy and international governance, business and economics, information technology and processing and electronics and engineering – which together represent more than 85% of all studies published, have a similar behavior, following the tendency of the general publication evolution presented in Figure 2.

Table 3 - Statistics per category

Category_group	Articles	Percentage	Average_citation	total_citations
SOCIAL SCIENCES AND HUMANITIES	604	38.37%	4.89	2 955
PUBLIC POLICY AND INTERNATIONAL GOVERNANCE	420	26.68%	5.14	2 158
BUSINESS AND ECONOMICS	356	22.62%	4.81	1 714
INFORMATION TECHNOLOGY AND PROCESSING	284	18.04%	9.30	2 640
ELECTRONICS AND ENGINEERING	145	9.21%	3.84	557
HEALTH AND BIOSCIENCES	27	1.72%	3.26	88
ENVIRONMENT	23	1.46%	15.26	351
EDUCATION	18	1.14%	0.39	7
ART	6	0.38%	0.50	3
MATERIALS AND CHEMISTRY	4	0.25%	1.00	4
ENERGY	1	0.06%	0.00	0
TRANSPORTATION	1	0.06%	0.00	0

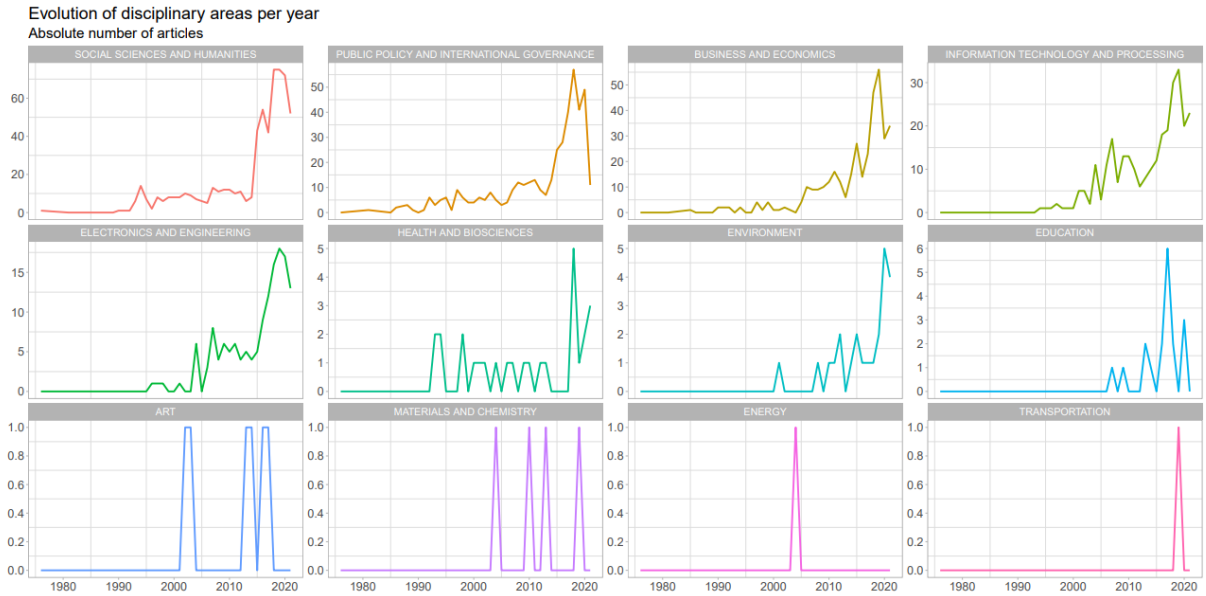

Figure 7 - Evolution of publishing per category.

Table 4 presents the top twenty most used keywords. The word “Corruption” leads the ranking and “Crypto Currency”, and “Bitcoin” closes the top 3, being that “Blockchain”, a technology usually linked to cryptocurrencies, appears in the 6th position. The words “Crime” and “Terrorism” close the top five. Finally, there are several words linked to the regulatory side presented in top twenty as “Regulation”, “CFT”, “Law” and “Compliance”.

Table 4 - Keywords ranking

Keywords	Rank
CORRUPTION	1
CRYPTO CURRENCY	2
BITCOIN	3
CRIME	4
TERRORISM	5
BLOCKCHAIN	6
MONEY	7
ORGANIZED CRIME	8
FRAUD	9
TERRORISM FINANCING	10
BANK	11
REGULATION	12
RISK	13
COMPLIANCE	14
CYBER CRIME	15
LAUNDER	16
MACHINE LEARNING	17
CFT	18
LAW	19
BENEFICIAL OWNERSHIP	20

Figures 8, 9 and 10 present the content dynamics on the studies published in Money laundering area by analyzing the keywords with major growth. The analysis is split into three approaches: focus on single words, two words and three or more words. For this analysis it was considered as relevant

keywords the ones with more than ten appearances in total. The figures show the presence and the growth of keywords: the color scale and the numbers represent the frequencies of appearances in a given year, while the Y-axis shows the keywords with the highest growth rates (year-on-year) in a descending order. The single words with highest growth are “corruption”, “money” and “crime”, while in the two words category appear “crypto currency”, “organized crime” and “terrorism financing”. All these words are also in the top twenty of most used keywords. Regarding the three or more words category, the words with higher growing tendency are “customer due diligence” and “financial intelligence unit”, none of them presented in the top twenty most used keywords.

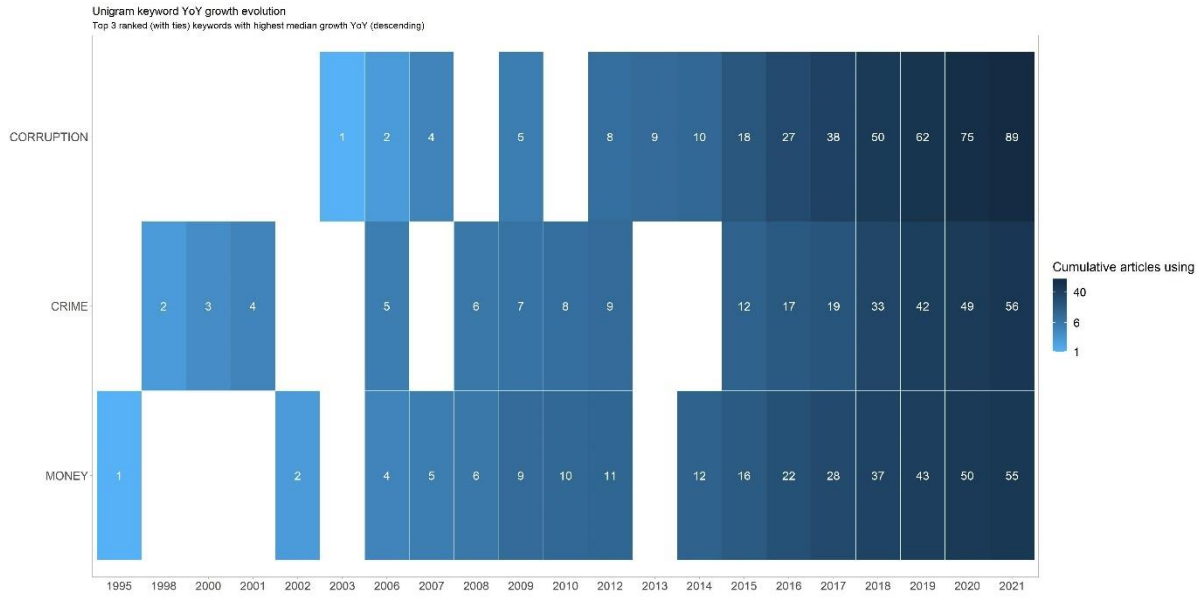

Figure 8 - Keywords with major growth: Unigrams

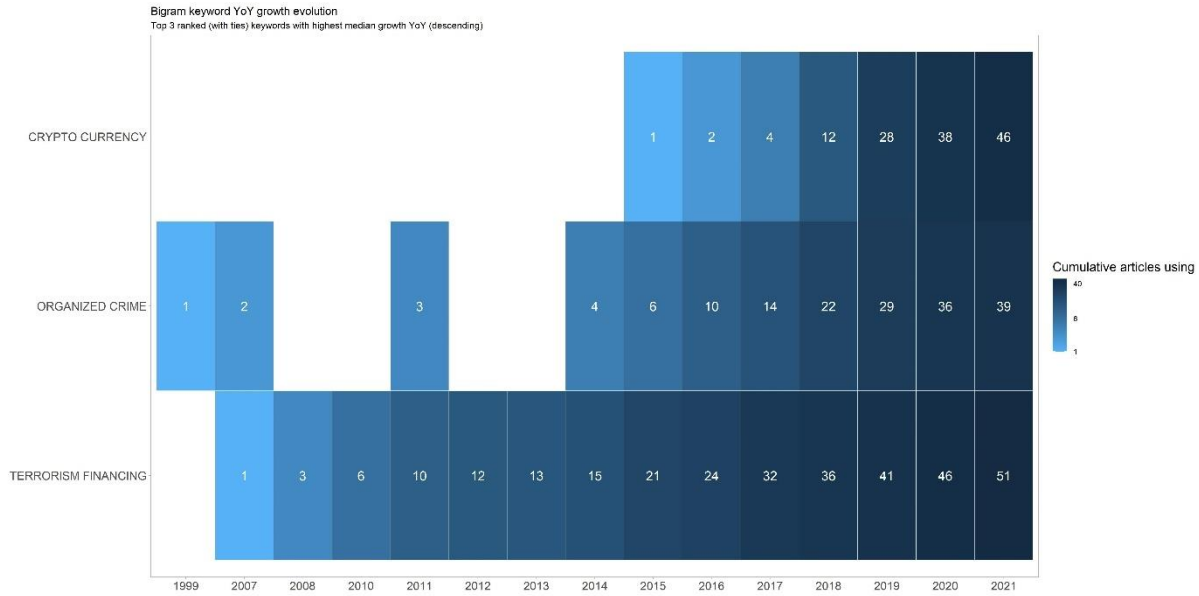

Figure 9 - Keywords with major growth: Bigrams

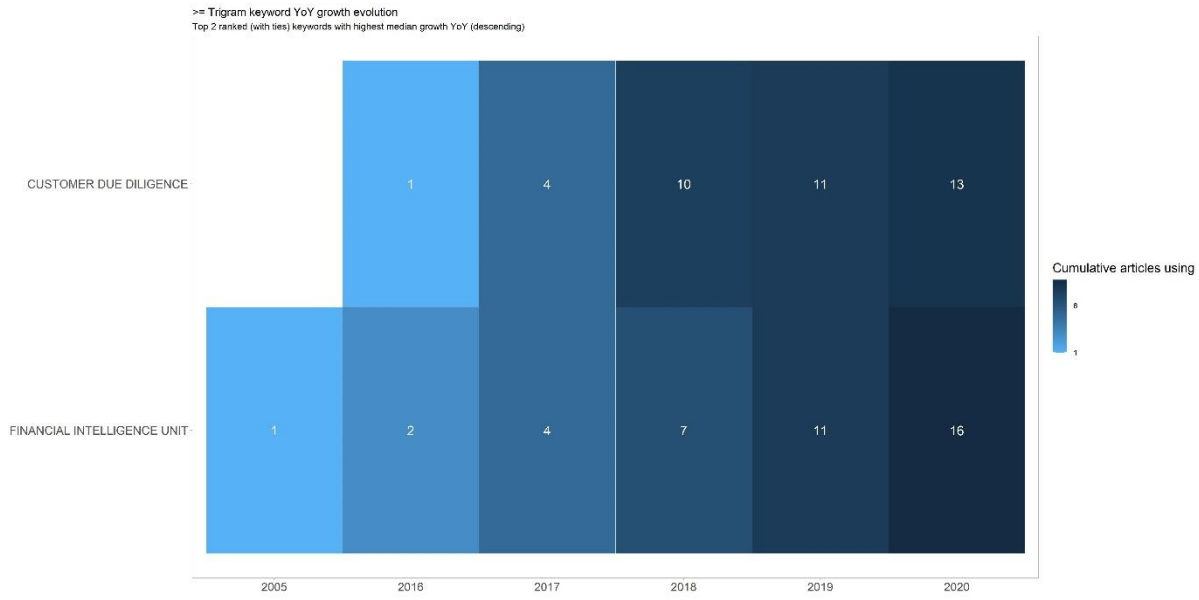

Figure 10 - Keywords with major growth: Trigrams

4.4. RELATION DYNAMICS

From the analyses of the keywords presented in the Figures 8, 9 and 10, it is possible to conclude that corruption is the leading theme associated with Money Laundering. Also, from the keywords analyses combined with the literature and the law, terrorism financing appears as a topic frequently associated with Money Laundering (10th most common keyword and 3rd two words keyword with major growth). Therefore, the author built the hypothesis of the quantity of science production or citations in or from a specific jurisdiction being related to the corruption perception index or global terrorism index. Finally, to address topics as cryptocurrency and financial intelligence unit the author found relevant to analyze the financial secrecy index, since the cryptocurrencies give a new way for criminals to launder significant amounts of money without being detected (Dupuis & Gleason, 2021). Considering that financial secrecy index also addressed law and regulations indicators, the keywords “regulation” and “beneficial ownership” are also covered by the financial secrecy index. This indicator aims to measure how transparent is an economy for a given country, being that as lower the score more transparent the country is. Again, the author built the hypothesis of science production or citations in or from a specific jurisdiction being related to the financial secrecy index.

Table 5 shows the results of the hypothesis test where the significant results are marked in green, and the non-significant ones are marked in red. The methodology used was Pearson correlations without assessing the impact of other possible variables as explanatory variables. Therefore, endogeneity problems can arise. Regarding the corruption perception index, only the number of articles per 1 million habitants showed a significant result (p-value lower than 0.05), being the variables are moderate and positively correlated with a coefficient of determination of 0.253. This correlation shows that countries which produce more articles per 1 million habitants are more likely to also show a higher corruption index score (a higher score means a less corruption perception). A coefficient of determination of approximately 25% also sets the corruption in a given country is far from being explained by the Money Laundering publishing. However, considering that corruption perception is a complex index, the hypothesis that higher publishing activity per 1 million habitants about Money

Laundering influences the populations' perception of corruption, cannot be dismissed. Figure 11 shows Switzerland as an outlier of this correlation, having this country a significant higher relation between the science production per 1 million habitants (4.84) and corruption perception index score (84).

Regarding the Financial Secrecy Index, the number of articles and the number of citations showed significant results (p-value lower than 0.05) with coefficient of determination of 0.521 and 0.492, respectively, and being both variables positively correlated to Financial Secrecy Index. Therefore, countries with more articles produced and more citations are more likely to have a higher Financial Secrecy Score (a higher score means a less transparent country). A coefficient of determination of approximately 50% does not set a strong explanation for countries financial secrecy. However, considering that the transparency of financial system is a complex theme, the hypothesis that higher knowledge about Money Laundering negatively influences the financial transparency of a given country cannot be dismissed. Figures 12 and 13 show that the 4 countries that more published, that are more cited and that are central nodes of country networks – USA, China, UK, and Australia – are also countries where the relation between the secrecy index and the total number of articles/citations is above the trend. The Global Terrorism Index results are not significant, so it is not possible to conclude something about it.

Table 5 - Correlation results

Variables	Number of articles		Number of articles per 1M habitants		Number of citations	
	R^2	p value	R^2	p value	R^2	p value
Corruption Perception Index	0.023	0.425	**0.253**	**0.005**	0.079	0.132
Global Terrorism Index	0.048	0.246	0.107	0.077	0.050	0.236
Financial Secrecy Index	**0.521**	**6.74313E-06**	0.027	0.389	**0.492**	**1.58813E-05**

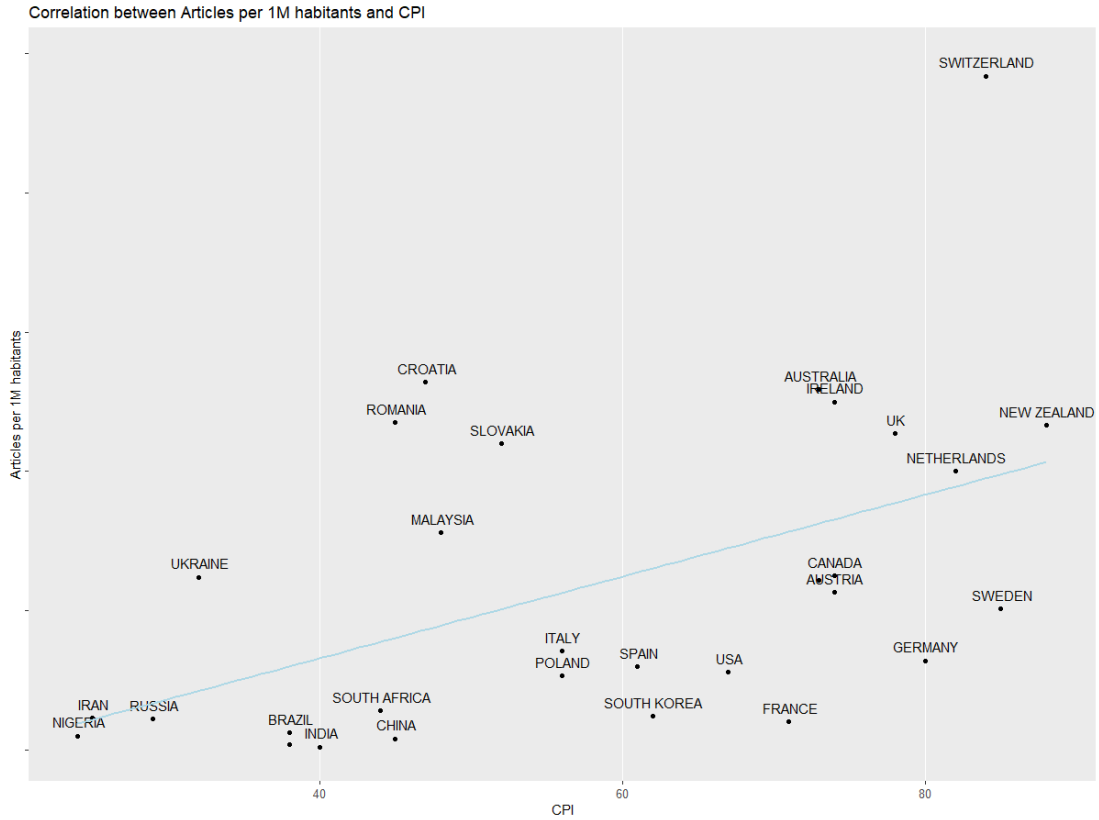

Figure 11 - Correlation between articles by 1M habitants and CPI

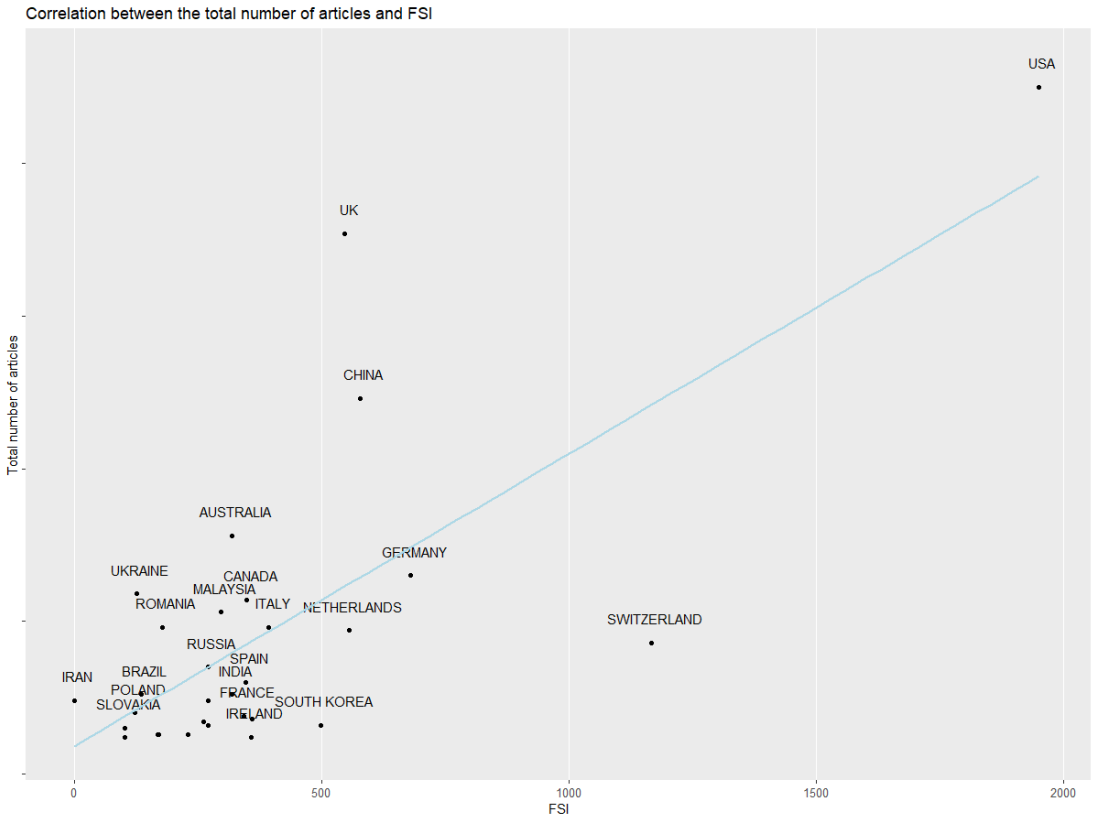

Figure 12 - Correlation between total articles and FSI

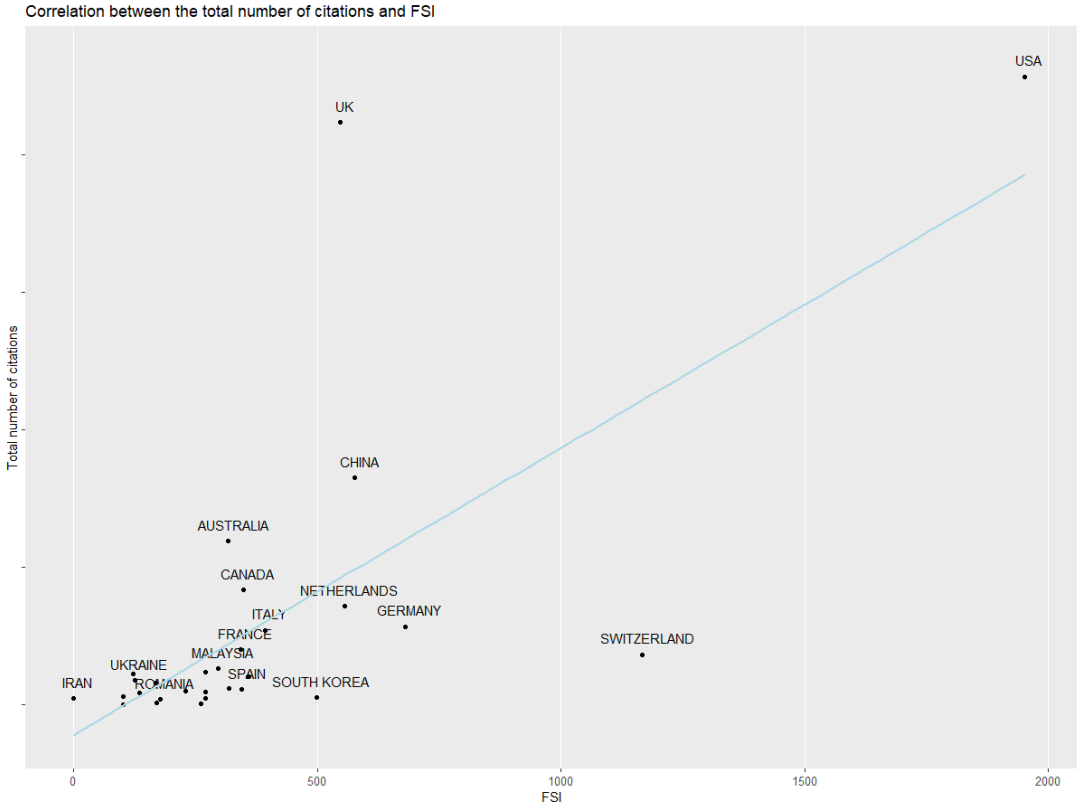

Figure 13 - Correlation between total citations and FSI

5. CONCLUSION

Money Laundering subject has turned into a relevant topic in science production since 2015. This might be justified by the end of the 2008s financial crises where less ethical behaviors in financial sector took place. A new worry about financial crime, including but not restricted to Money Laundering, might lead to a new era on Money Laundering subject.

This study showed there are clearly four main players in publishing about Money Laundering – USA, China, UK, and Australia – existing also a fifth player in production per capita – Switzerland. The four major players are also the central nodes of country knowledge networks.

One of the most themes linked with Money Laundering in the law and regulation is terrorism financing. However, it was not possible to conclude about the relation between science production and the Global Terrorism Index. On the other side it was found a good correlation (coefficient of determination close to 0.5) between science production and number of citations, and the Financial Secrecy Index. This correlation shows that countries with more articles produced, and with more citations are more likely to be less transparent. Therefore, it seems there is a dealignment between the law and the Money Laundering expert countries: while the law has been mainly focused on terrorism financing, the expert countries in Money Laundering shows less transparent economies.

Further steps of this work could be the analysis of the institutions which are linked to the Money Laundering publishing activity and assess the nature behind Money Laundering knowledge creation. Also, a deeper study about relation between Money Laundering publishing activity and countries corruptions, financial transparency and terrorism might be conducted. Other opportunity for further work is to understand how the keywords are linked between each other to better understand next challenges on combating Money Laundering.

This study can be faced as a starting point to explore more effective ways on combating money laundering, by combining efforts within the countries with more expertise in this area. Despite the correlations presented in this study can contain endogeneity problems, it opens a hypothesis to explore how countries are leading their knowledge about Money Laundering. This study also helps the policy makers to be aware about the themes associated with Money Laundering and how to adapt the law and regulations to improve the combat against this crime, as for example improve regulation on the cryptocurrencies area.

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7. APPENDIX A

SC	Category_group
ENGINEERING	Electronics and engineering
GOVERNMENT & LAW	Public policy and international governance
CRIMINOLOGY & PENOLOGY	Social sciences and humanities
BUSINESS & ECONOMICS	Business and economics
AUTOMATION & CONTROL SYSTEMS	Information technology and processing
COMPUTER SCIENCE	Information technology and processing
SOCIAL SCIENCES - OTHER TOPICS	Social sciences and humanities
AREA STUDIES	Social sciences and humanities
INTERNATIONAL RELATIONS	Public policy and international governance
SCIENCE & TECHNOLOGY - OTHER TOPICS	Electronics and engineering
PUBLIC ADMINISTRATION	Public policy and international governance
PHYSICS	Electronics and engineering
ARTS & HUMANITIES - OTHER TOPICS	Social sciences and humanities
DEVELOPMENT STUDIES	Social sciences and humanities
METALLURGY & METALLURGICAL ENGINEERING	Electronics and engineering
EDUCATION & EDUCATIONAL RESEARCH	Education
COMMUNICATION	Social sciences and humanities
CHEMISTRY	Materials and chemistry
LEGAL MEDICINE	Health and biosciences
SOCIOLOGY	Social sciences and humanities
GENERAL & INTERNAL MEDICINE	Health and biosciences
ENVIRONMENTAL SCIENCES & ECOLOGY	Environment
HISTORY	Social sciences and humanities
FORESTRY	Materials and chemistry
INFORMATION SCIENCE & LIBRARY SCIENCE	Information technology and processing
ART	Art
MUSIC	Art
LINGUISTICS	Social sciences and humanities
ANTHROPOLOGY	Health and biosciences
MATHEMATICS	Information technology and processing
TELECOMMUNICATIONS	Electronics and engineering
MECHANICS	Electronics and engineering
PSYCHOLOGY	Health and biosciences
SUBSTANCE ABUSE	Social sciences and humanities
HEALTH CARE SCIENCES & SERVICES	Health and biosciences
GEOGRAPHY	Social sciences and humanities
DENTISTRY, ORAL SURGERY & MEDICINE	Health and biosciences
LITERATURE	Social sciences and humanities
MATHEMATICAL METHODS IN SOCIAL SCIENCES	Social sciences and humanities
PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	Health and biosciences
DEMOGRAPHY	Social sciences and humanities
OPERATIONS RESEARCH & MANAGEMENT SCIENCE	Information technology and processing
RELIGION	Social sciences and humanities
MATERIALS SCIENCE	Materials and chemistry
ENERGY & FUELS	Energy
BIOTECHNOLOGY & APPLIED MICROBIOLOGY	Materials and chemistry
ARCHITECTURE	Art
AGRICULTURE	Environment
THEATER	Art
ARCHAEOLOGY	Environment
TRANSPORTATION	Transportation
PHARMACOLOGY & PHARMACY	Health and biosciences
SOCIAL ISSUES	Social sciences and humanities
IMAGING SCIENCE & PHOTOGRAPHIC TECHNOLOGY	Electronics and engineering
PSYCHIATRY	Health and biosciences
FOOD SCIENCE & TECHNOLOGY	Materials and chemistry
URBAN STUDIES	Social sciences and humanities
ASIAN STUDIES	Social sciences and humanities
ETHNIC STUDIES	Social sciences and humanities
OPTICS	Electronics and engineering
REMOTE SENSING	Information technology and processing
INSTRUMENTS & INSTRUMENTATION	Information technology and processing